Form ESA-B4. Final Public Report ESA-129-2

Company	General Motors Corporation	**ESA Dates**	October 16-18, 2007
Plant	Truck Assembly Plant	**ESA Type**	Steam
Product	Automobile Manufacturing & Assembly	**ESA Specialist**	Riyaz Papar, PE, CEM
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ENERGY SAVINGS OPPORTUNITY SUMMARY INFORMATION					
Identified Opportunity	**Savings/yr**				
			MMBtu	**Fuel Type**	**N,M,L**
Other – Reduce deaerator operating pressure			7,768	Natural gas	N
Improve insulation			1,409	Natural gas	N
Implement steam trap maintenance program			2,224	Natural gas	N

IDENTIFIED PLANT BEST PRACTICES	
Site level integration and optimization	Significant amount of instrumentation for analysis
Use of real-time operating data	Good (>80%) condensate return
Feedwater economizers on boilers	Boiler blowdown ~1-1.5% based on conductivities
Automatic oxygen trim controllers	Good boiler integrity
Monitoring of critical parameters – steam, fuel, etc	Optimized fuel selection for steam generation
Boiler blowdown flash steam recovery	Good overall plant distribution insulation
Condensate flash to steam at lower pressure	Good record and log of water treatment

Brief Narrative Summary Report for the Energy Savings Assessment

Introduction:
The General Motors Truck Assembly Plant, Shreveport, LA was the focus of a 3-day steam system Energy Savings Assessment (ESA). The plant site is well spread out and consists of a Stamping facility, Body Shop and General Assembly. The site has ~1,000,000 sq. ft of covered space with most of it having high ceilings (40 ft). The plant also has a central Powerhouse that supplies steam, chilled water and compressed air to all the facilities on site. The Powerhouse is operated by a third-party (Duke Energy Generation Services) and General Motors pays for the fuel and electricity. The utility infrastructure at the Shreveport Plant is integrated across the facilities. The Powerhouse generates saturated steam at 240 psig using a combination of landfill gas and natural gas. The Shreveport plant has negotiated their utility rates and tariff structures in such a manner that they can maximize the use of landfill gas for steam generation. Saturated steam from the Powerhouse at 240 psig is appropriately pressure reduced to 35 psig for use in process heating tanks and preheat / reheat in the paint shop's Air Supply Houses (ASH units) in the assembly plant. Although there is no sub-metering within the battery limits of the assembly plant, the Energy and Utilities personnel track and trend demand and usage of the steam generated at the Powerhouse.

Objective of ESA:
The main objectives of the ESA were as follows:
- Identify steam system energy savings opportunities for the GM Shreveport plant steam system
- Use the DOE Steam tools such as the Steam System Scoping Tool (SSST), System Assessment Tool (SSAT) and the 3E Plus insulation software to model the steam system at the plant
- Assist plant personnel to gain familiarity and use all the above mentioned tools to identify energy efficiency improvement opportunities at the plant and quantify the energy savings associated with the steam system

Focus of Assessment:
Steam system at the GM Truck Assembly Plant, Shreveport, LA

Approach for ESA:
The ESA core plant team included personnel from GM Utilities Operations and Duke Energy. These people have varied responsibilities for the steam system ranging from energy system optimization, maintenance and reliability. The team completed the Steam System Scoping Tool (SSST) at the start of the ESA. The ESA Specialist then spent time understanding the plant's steam system that included generation, distribution, end-use and recovery. The core team was provided with an overview and usage of the Steam System Assessment Tool (SSAT) and the projects therein to do "what-if" analysis. The SSAT model was used to quantify the potential energy savings opportunities. A 2-pressure header steam system was used to model the steam system at the plant. Nevertheless, the use of SSAT as an "impact model" was also demonstrated to show its versatility. Necessary data required for use in the SSAT model was collected from the data acquisition and historian system during the ESA.

General Observations of Potential Opportunities:
There is a high degree of industry BestPractices in place at the Powerhouse and the plant, which is reflected in the above average score (80%) that the plant received on the SSST.

The overall steam demand at the plant is a strong function of the season (ambient temperature). This is because all the ASH units on the paint booths are 100% outdoor air. There is no air recycle and hence, ambient conditions dictate both the steam heating, humidification and cooling loads. The plant's steam load profile can be best described with three seasons – Winter (November-February), Shoulder and Summer (May-September). Average steam demand in winter is ~90 MPPH. The summer steam demand averages almost the same as the winter demand since a 4,000 RT condensing steam-turbine driven chiller is used to supply the cooling demand. This condensing steam turbine consumes ~45 MPPH.

There are three water-tube boilers at the Powerhouse. Boiler #1 is rated at 100 MPPH and uses only natural gas. Boilers #2 and #3 are rated at 150 MPPH and use landfill gas and natural gas. At most times, only one of two boilers #2 or #3 are operating and using as much landfill gas as possible. The remainder of the duty is supplied by natural gas. There is also one boiler that is kept on warm standby. Typical operation is 5 days a week and boilers are shutdown over the weekend. The annual natural gas usage for steam production at the Powerhouse is ~250,000 MMBtu and landfill gas ~350,000 MMBtuAlthough the detailed evaluation of end-use was out of the scope of this ESA, an effort was made to visit with Paint shop personnel, understand any immediate steam related issues and discuss any thoughts and ideas they have had. The core team also spent time during the ESA walking and inspecting the steam distribution system, visiting the Paint shop ASH units and phosphate tank heat exchangers and condensate collection tanks and return units.

Based on the Steam ESA, energy savings opportunities do exist in the steam system. These energy savings opportunities are quantified in the table on Page 1 and are described briefly below and identified as Near, Medium and Long term (please refer to the definitions at the end of the report).

1. Other – Reduce Deaerator operating pressure (Near Term Opportunity)

The deaerator operating pressure is ~35 psig at the Powerhouse. But all the condensate which is returned is at atmospheric pressure and at ~150°F. This implies that the deaerator heats all the condensate and make–up water to the saturation temperature (280°F). It uses live steam from the 35 psig header to do so. If the deaerator were operated at a lower pressure (10 psig), a reduced amount of steam would be needed. Secondly, the boiler feedwater (BFW) enters the economizer and currently, the stack gas exhaust temperatures are ~375-400°F, since the BFW is already 280°F. Reducing the deaerator pressure would reduce the BFW temperature and lead to lower exhaust temperatures. This would lead to boiler efficiency improvement.

2. Improve Insulation – Boiler area & site-wide (Near Term Opportunity)

Overall the insulation at the plant is very good but there are a few areas that may benefit from improved insulation practices. The 3EPlus insulation program was used to estimate the energy loss from un-insulated areas. For example, the inspection channel flanges on the steam and mud drums of all the boilers. Surface temperatures in these sections were found to be ~400°F. Apart from the energy loss, this represents a personnel safety issue. There are also areas in the Paint Shop that can benefit from insulation. It is recommended to do a plant-wide insulation appraisal since it was out of the scope of this ESA.

3. Implement Steam Trap Maintenance Program (Near Term Opportunity)

The Utilities and Energy team have started to establish a database of steam traps and taken steps to develop a good steam trap maintenance program. It is found that ~10% of traps fail in the industry every year and repairing or replacing these traps will add to energy and cost savings. Since almost all the traps end in atmospheric condensate tanks, a good indication of trap failure is receiver vents. It is strongly recommended that the Utilities and Energy team work towards developing a world-class steam trap maintenance program which includes proper trap selection, steam trap database, annual inspection of all traps for performance and an immediate repair/replace procedure for failed traps. Note that the ESA did not allow for a detailed steam trap audit. Additionally, the SSAT was used to estimate potential savings opportunities based on history.

4. Other opportunities & BestPractices

During the course of the ESA, there were other opportunities that were briefly investigated but a much more detailed due diligence is required to quantify energy savings and implementation. Additionally, some bestpractices that can be put into practice immediately are also mentioned in this section.

- <u>Continue real time monitoring and add trending of efficiency (BestPractice)</u>

Critical data from different production units is currently collected in the Powerhouse's DAS. With some very simple equations, condensing turbine efficiency, heat exchanger effectiveness, etc. can be calculated real-time and trended. This will allow for tracking performance and help to predict any upcoming maintenance issues.

- <u>Continuous evaluation of condensing steam turbine chiller operation (BestPractice)</u>

The Powerhouse operates a condensing steam turbine chiller. This consumes ~45 MPPH of 240 psig steam. Based on calculations this provides ~3,200 kW. In most cases, given current natural gas prices, it is very difficult to justify the operation of a condensing steam turbine. Hence, an evaluation was done during this ESA to see the economic ramifications of shutting down the condensing steam turbine. Nevertheless, a continuous evaluation of condensing steam turbine economics is recommended from an optimization perspective.

- <u>Evaluation of boiler operating pressure reduction (BestPractice)</u>

Reducing boiler operating pressure is a classic recommendation but it has to evaluated carefully before implementing it. Unless, the end-use pressure is reduced, savings are only available upstream. Since the plant produces steam at 240 psig but uses it at 35 psig, this opportunity was discussed to a significant extent. The US DOE Steam BestPractices Technical Publication on Steam Pressure Reduction (http://www1.eere.energy.gov/industry/bestpractices/techpubs_steam.html) was referenced and used as a guide to determine if there would be any benefit to the plant by reducing the boiler operating pressure. Efficiency gains would occur due to slightly lower stack exhaust temperature, reduced leak loss and lower heat loss upstream of the pressure reducing valve. But given the fact that the steam condensing turbine needs the highest inlet pressure possible from an efficiency perspective and that the end use is still going to demand 35 psig steam, there is almost no advantage to reducing the boiler operating pressure. In the future, this opportunity can be re-evaluated if downstream conditions change.

Management and UAW Support and Comments:
A corporate level management team and the UAW/WFG Joint Task Team encourage any effort that reduces the Energy usage at all of its plants located around the country. General Motors has a target to reduce energy use and costs by 6% this year. They have an Energy Engineer with this assignment at each facility.

Management at the Shreveport assembly plant has been very supportive of the time and effort put in by the Energy and Utilities team. The plant was recently selected to receive an Energy Award for energy conservation efforts in 2006. This is proof positive that energy reduction goals set by UAW/WFG Joint Task Teams Best Practices and Management are being met at the Shreveport Assembly plant. Nevertheless, plant personnel continue to pursue additional energy saving (cost cutting) opportunities that are economically viable.

The UAW/WFG Joint Task Teams have identified several Department of Energy (DOE) best practices that will have a significant impact if implemented at GM Facilities. Due to the focus of the Best Practices there is an opportunity for our UAW Skilled Trades to provide a substantial cost savings impact to the operating costs of our facilities by working jointly with the GM/WFG management organization.

UAW/WFG Joint Task Team, DOE associated Best Practices:
BMES-01 Pumping System Assessment Tool
BMES-02 Air Master + Diagnostic Tool
BMES-03 Motor Master + Diagnostic Tool
BMES-04 Steam System Assessment Tool
BMES-07 Fan system Assessment Tool
BMES-09 Chilled Water System Assessment Tool

The UAW Skilled Trades working in conjunction with the GM/WFG Energy & Utilities Services Group (EUSG) and the GM/WFG Facilities Management Group (FM) can jointly pursue the effort to optimize the operating efficiencies of these major systems that are found in GM facilities.

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The definitions for Near Term, Medium Term, Long Term opportunities are as follows:
- Near term opportunities would include actions that could be taken as improvements in operating practices, maintenance of equipment or relatively low cost actions or equipment purchases.
- Medium term opportunities would require purchase of additional equipment and/or changes in the system such as addition of recuperative air preheaters and use of energy to substitute current practices of steam use etc. It would be necessary to carry out further engineering and return on investment analysis.
- Long term opportunities would require testing of new technology and confirmation of performance of these technologies under the plant operating conditions with economic justification to meet the corporate investment criteria.